

Exhibit A

ENGLISH TRANSLATION OF SHIRO REFERENCE (JP 2002-174204)

...

[0009] Located in the cylinder body 10 is a piston body (assembly) 30 which is non-contact with the cylinder body 10. The piston body 30 has, in order from above in Figs. 1 and 2, a spacer body 31, a second diaphragm retainer 32, and a third diaphragm retaining body 33. Screwed together and fixed at a central portion of the spacer body 31 is a work rod 34 which passes through each center of the second diaphragm retainer 32 and the third diaphragm retaining body 33 to extend from a lower opening portion of the cylinder body 10 to the outside. Central portions of the first diaphragm 21 and the second diaphragm 22 are positioned respectively at upper and lower surfaces of the spacer body 31 as shown in Figure, and a central portion of the third diaphragm 23 is supported by the third diaphragm retaining body 33. Consequently, a first pressure chamber P1 is formed (partitioned) by the upper body 11 of the cylinder body 10, the first diaphragm 21, and the piston body 30; and a second pressure chamber P2 is formed (partitioned) by the lower body 13 of the cylinder body 10, the second diaphragm 22, the third diaphragm 23, and the piston body 30. Pressure-receiving areas of the first diaphragm 21 and the second diaphragm 22 are larger than a pressure-receiving area of the third diaphragm 23.

[0010] Formed in the upper body 11 is a fluid sucking/exhausting hole 11b communicating with the first pressure chamber P1, and formed in the lower body 13 is a fluid sucking/exhausting hole 13b communicating with the second pressure chamber P2. The fluid sucking/exhausting holes 11b and 13b are connected to a compressed-air source 17 via a control valve device 15 and a regulator 16 (see Fig. 2). The control valve device 15 is a device for supplying controlled positive pressure selectively or simultaneously to the first pressure chamber P1 and the second pressure chamber P2, and interiors of the first pressure chamber P1 and the second pressure chamber P2 never become in negative-pressure states.

...

[0012] Even when a pressure relation between the first pressure chamber P1 and the second pressure chamber P2 varies in high and low, the first diaphragm 21 and the second diaphragm 22 do not vary in their respective expanding directions (are each kept in an expanding state of approaching to each other), thereby making it possible to maintain high durability. In addition, as shown in Fig. 6, the first diaphragm 21 and second diaphragm 22 are diaphragms in which their foundation clothes 21b and 22b are located respectively at one surfaces of rubber base materials 21a and 22a, wherein the foundation clothes 21b and 22b are positioned at opposite surfaces located on sides of being expanded to each other.

[0013] Supported between the spacer body 31 of the piston body 30 and the second diaphragm retainer 32 is a central portion of a low frictional sheet 52 together with the second diaphragm 22. The low frictional sheet 52 is made of, for example, a polytetrafluoroethylene resin sheet, and positioned between the first diaphragm 21 and the second diaphragm 22. When the piston body 30 is not inclined as well as even when it is inclined up to any angles, the low frictional sheet 52 is provided at a position where the first diaphragm 21 and the second diaphragm 22 are prevented from being contacted to each other (a position where the low frictional sheet 52 contacts the first diaphragm 21 and the second diaphragm 22).

[0014] This tiltable cylinder device controls compressed air (positive pressure) which is supplied to the first pressure chamber P1 and the second pressure chamber P2 via the compressed-air source 17, the regulator 16, and the control valve device 15, thereby causing the piston body 30 to move forward/backward with respect to the cylinder body 10, so that work is carried out by the work rod 34. At this time, the piston body 30 is connected to the cylinder body 10 via the first diaphragm 21, second diaphragm 22, and third diaphragm 23 which are flexible, and is non-contact with the cylinder body 10, thereby making it possible to tilt (Figs. 4 and 5).

[0015] Further, according to the present embodiment, even when the piston body 30 adopts any posture, the first diaphragm 21 and the second diaphragm 22 do not contact to each other. That is, although the first diaphragm 21 and the second diaphragm 22 contact to the low frictional sheet 25, they never contact to each other. The low frictional sheet 25 has a low frictional property, and so does not cause abnormal noise to occur even when contacting to and sliding the first diaphragm 21 and the second diaphragm 22. Therefore, the first diaphragm 21 and the second diaphragm 22 are never possibly caused to be damaged due to mutual contact and slide.

...